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Weber et al.

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(54) **SUPPORT TABS FOR PROTECTING A CIRCUIT BOARD FROM APPLIED FORCES**

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Related U.S. Application Data

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H05K 7/02 (2006.01)
H05K 7/04 (2006.01)

(52) **U.S. Cl.**
USPC **361/807**; 361/810; 361/809

(58) **Field of Classification Search**
USPC ..... 361/807, 728–730, 752, 796, 800, 809, 361/810; 174/138 E, 138 G
See application file for complete search history.

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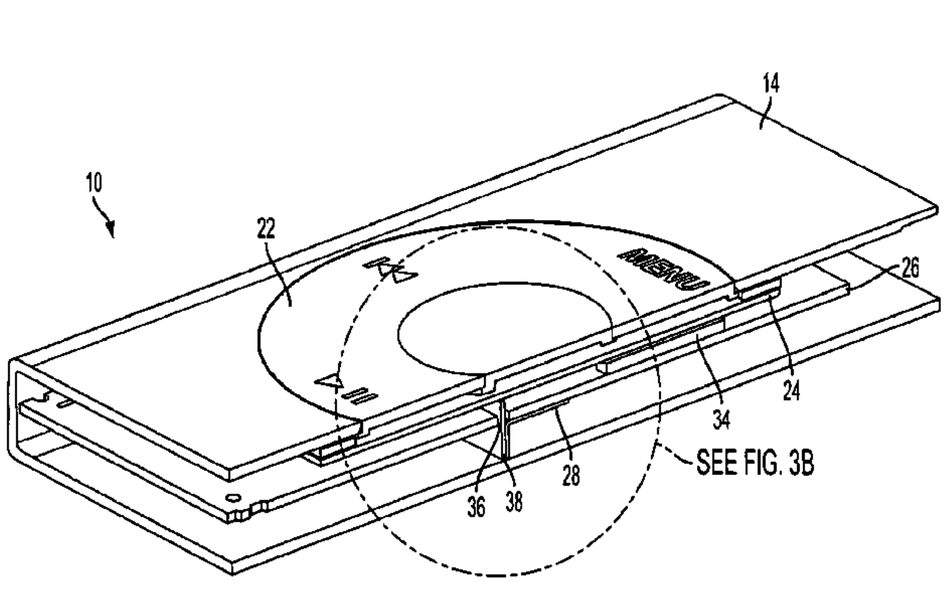
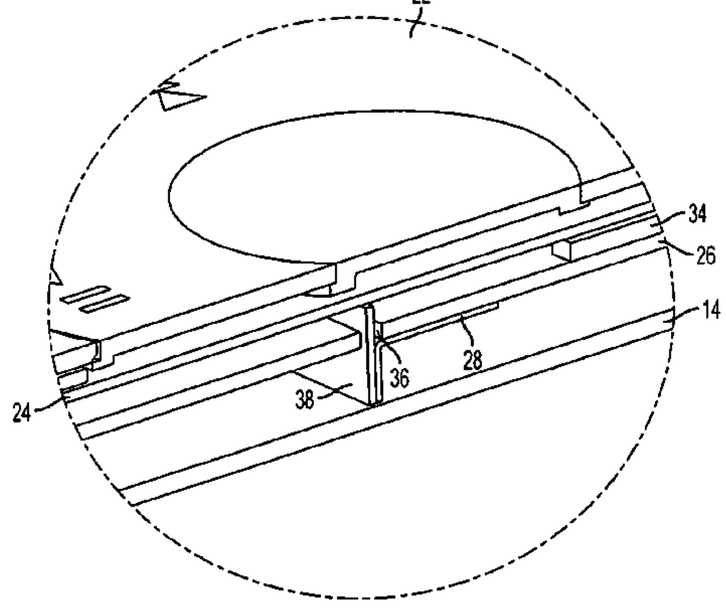
Primary Examiner — Hung S Bui
(74) *Attorney, Agent, or Firm* — Jennifer Luh

(57) **ABSTRACT**

The present invention can relate to an electronic device having one or more support tabs that protect a circuit board disposed inside the device from externally applied compressive forces. In particular, when a force is applied to a housing of the device, the support tabs can buttress the housing of the device, either directly or through other intervening components disposed within the device, to reduce the likelihood that the housing or intervening components will contact and damage the circuit board. The present invention also can relate to methods for manufacturing such an electronic device.

45 Claims, 14 Drawing Sheets





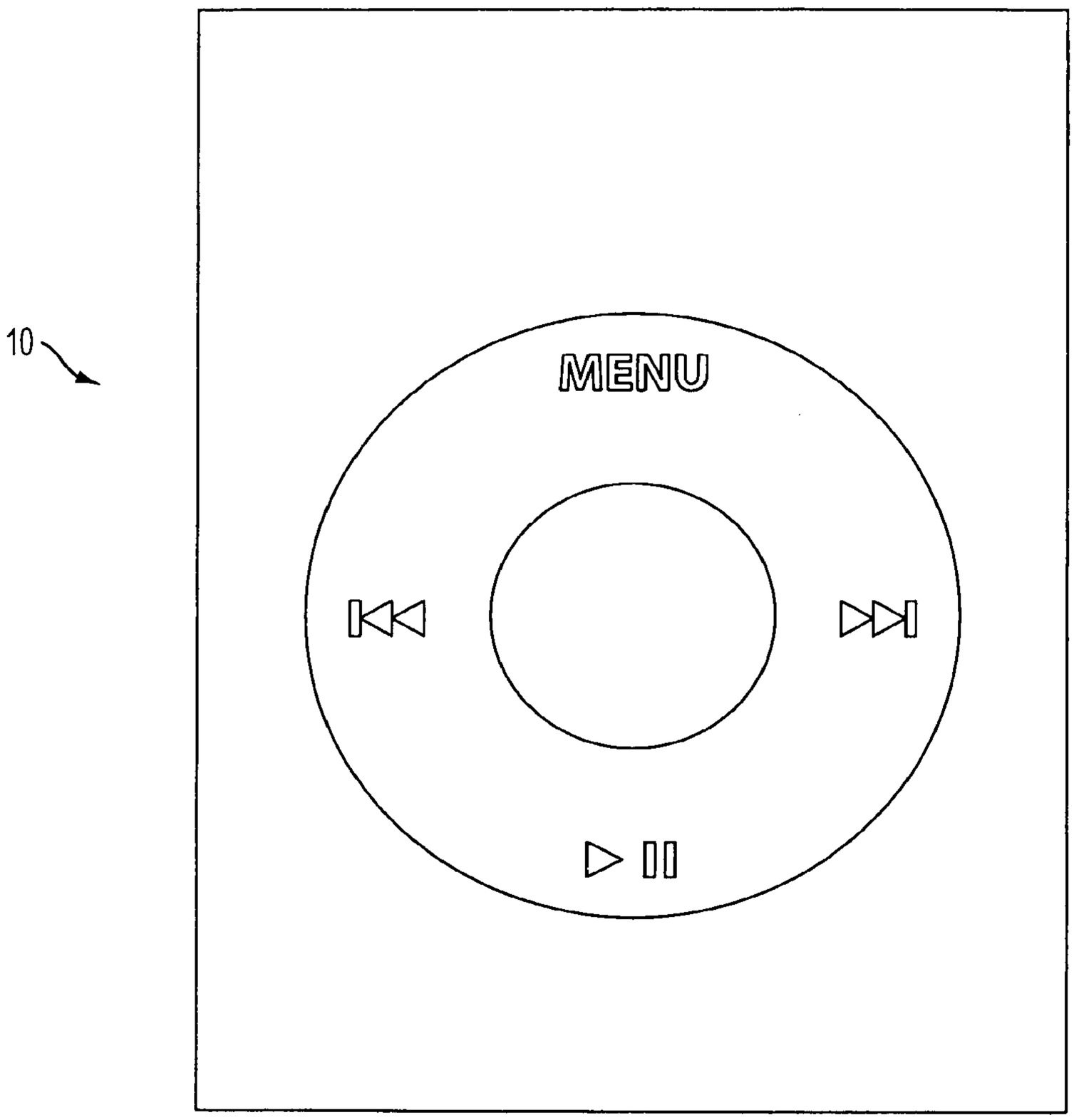


FIG. 1A

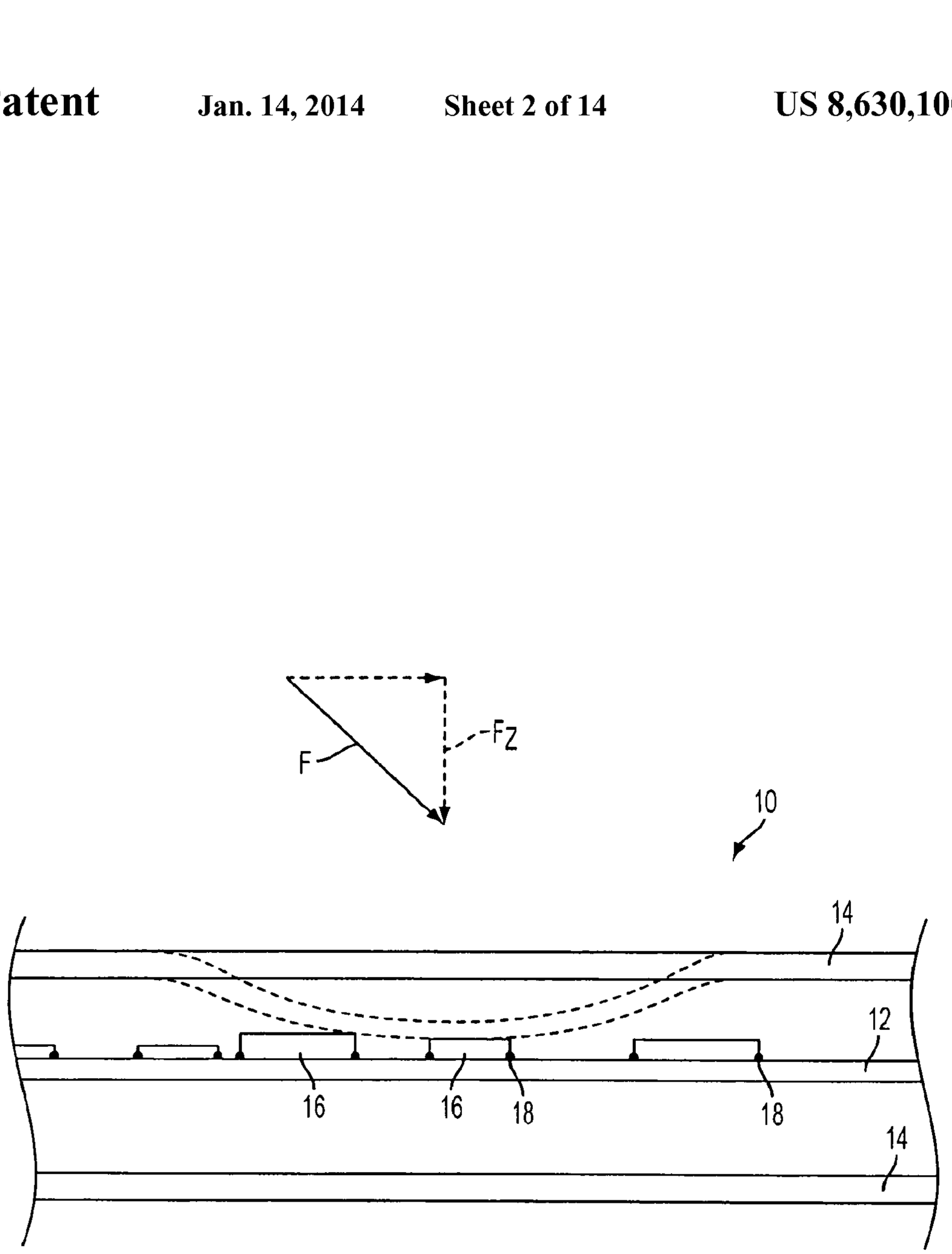
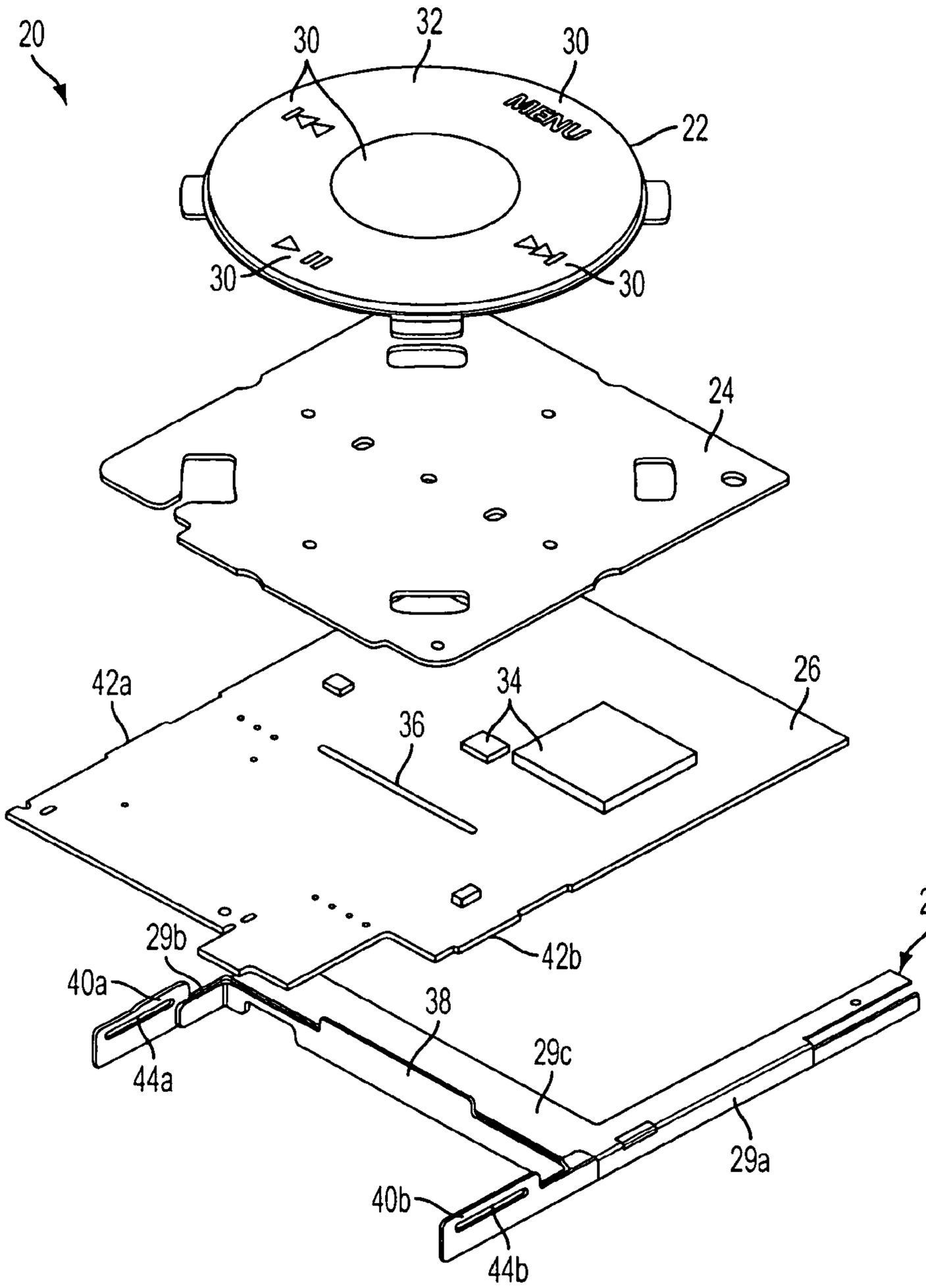


FIG. 1B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29c
44a
29a
40b
44b

FIG. 2

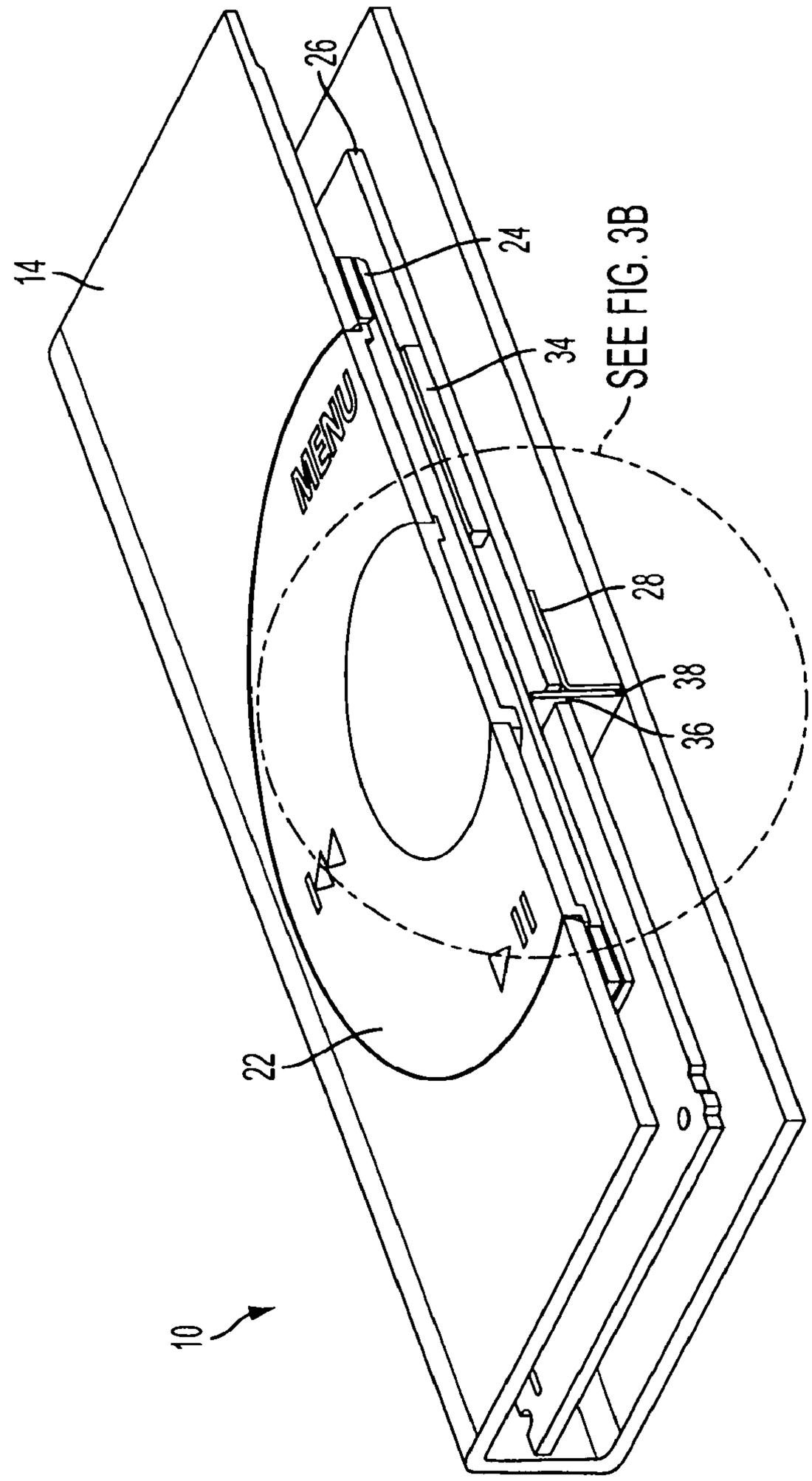


FIG. 3A

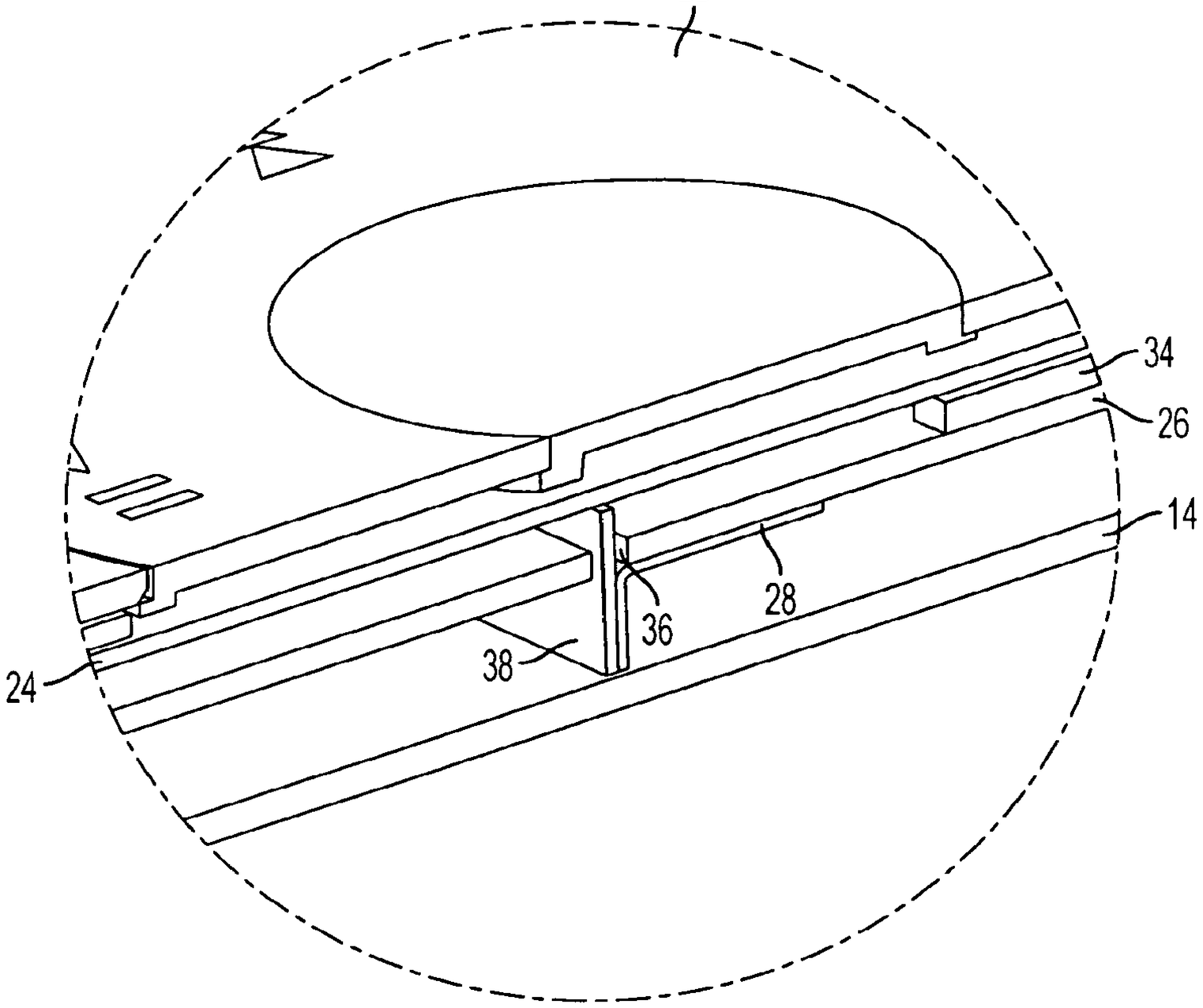


FIG. 3B

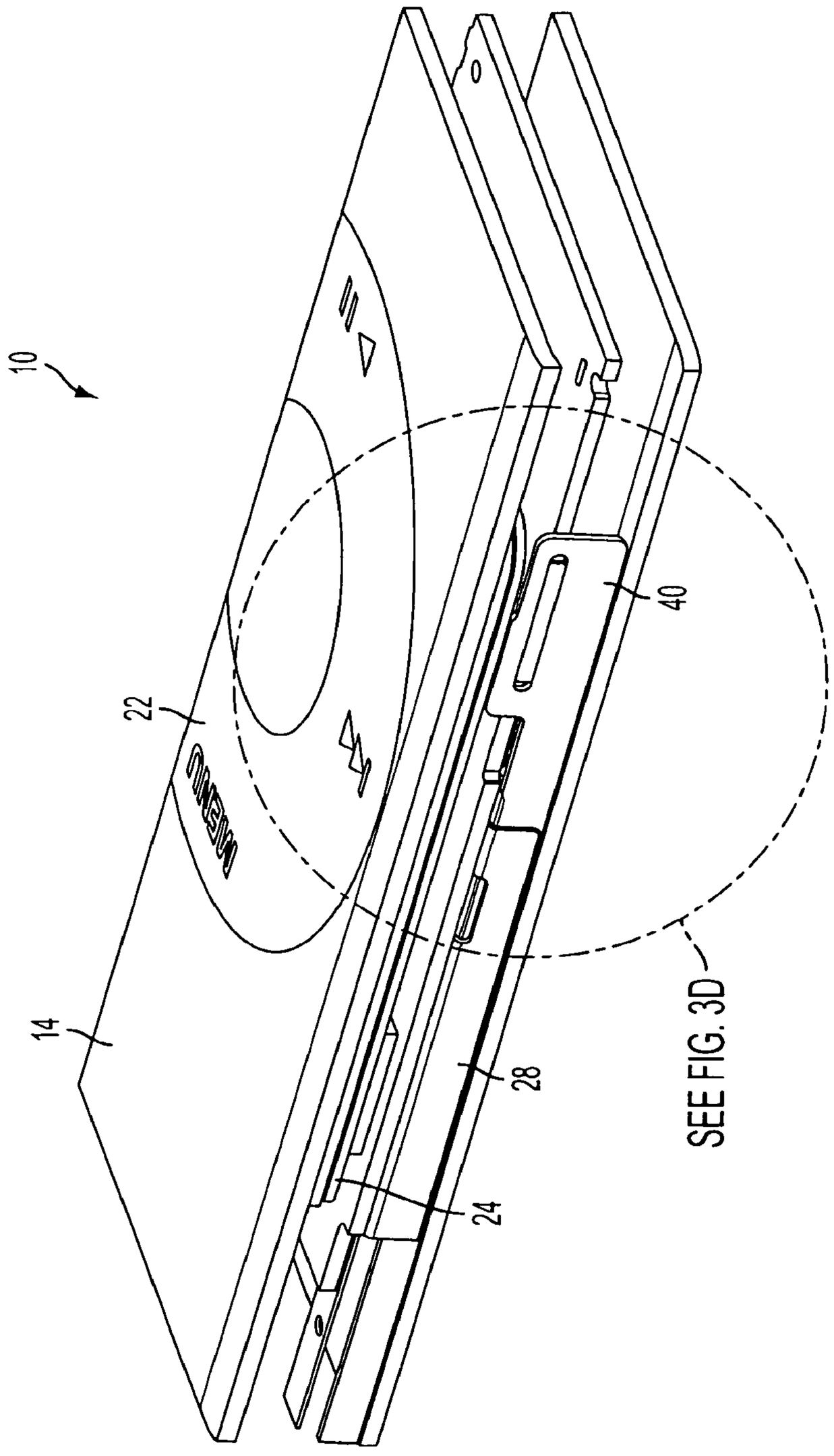


FIG. 3C

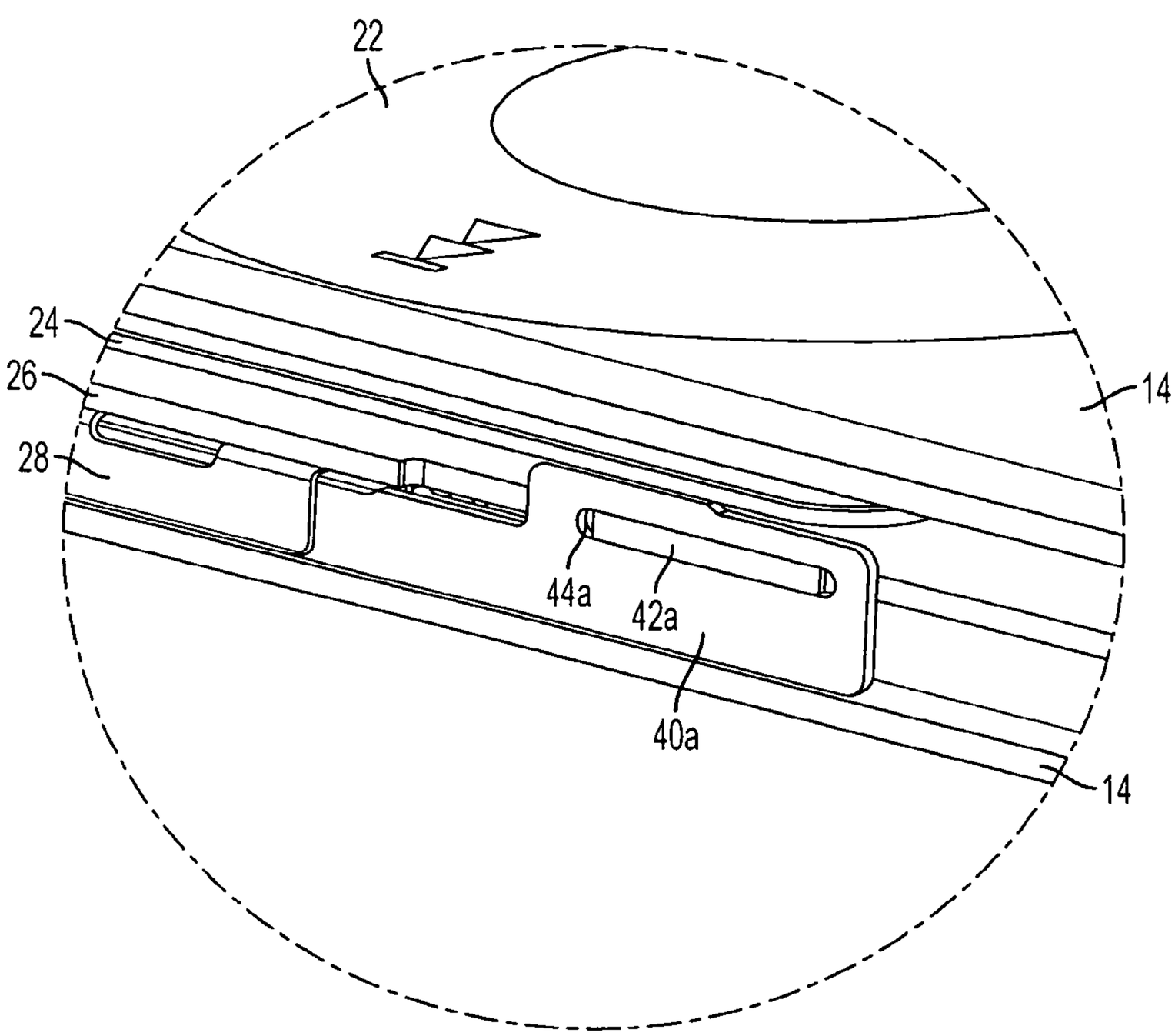


FIG. 3D

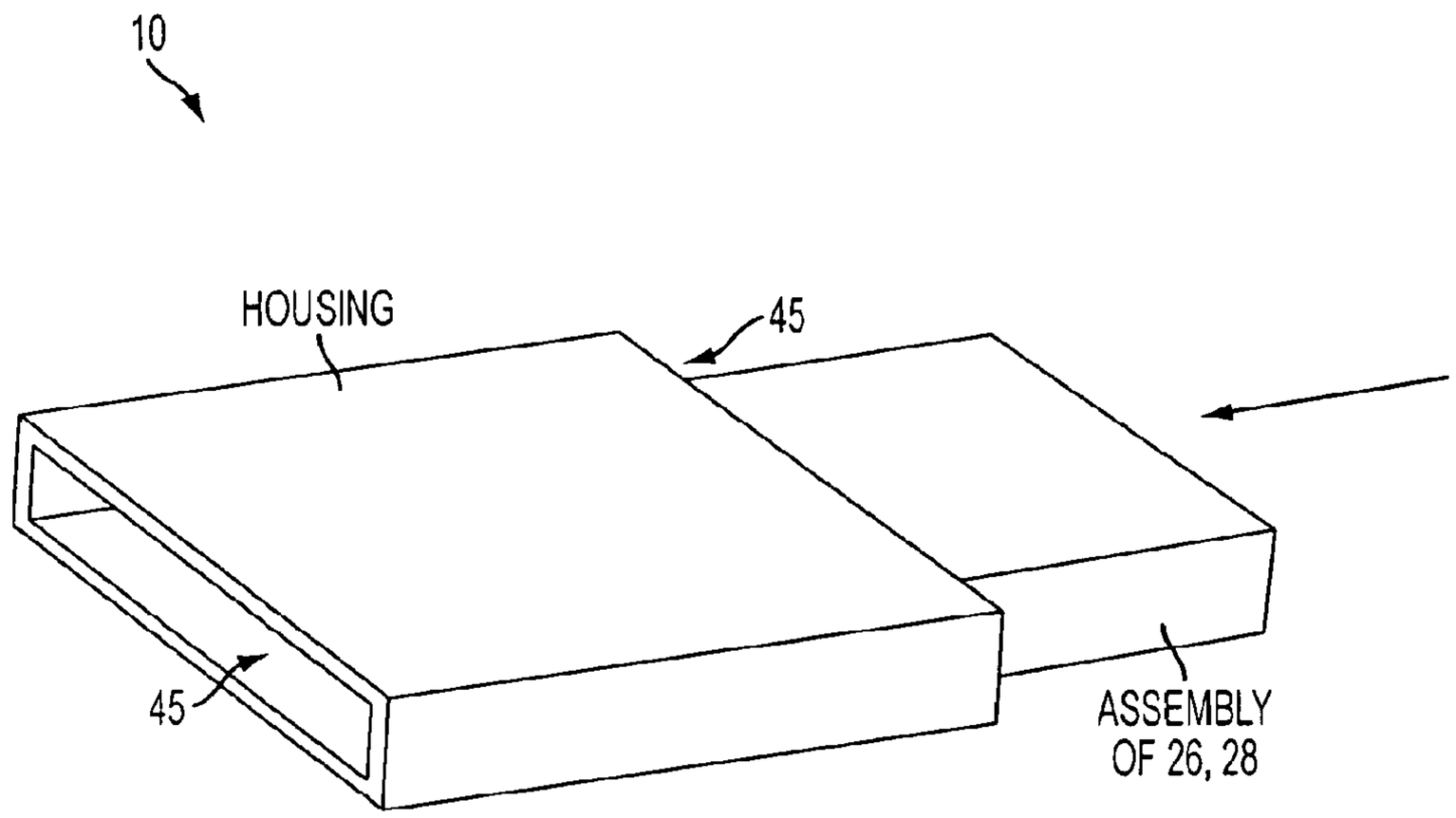


FIG. 3E

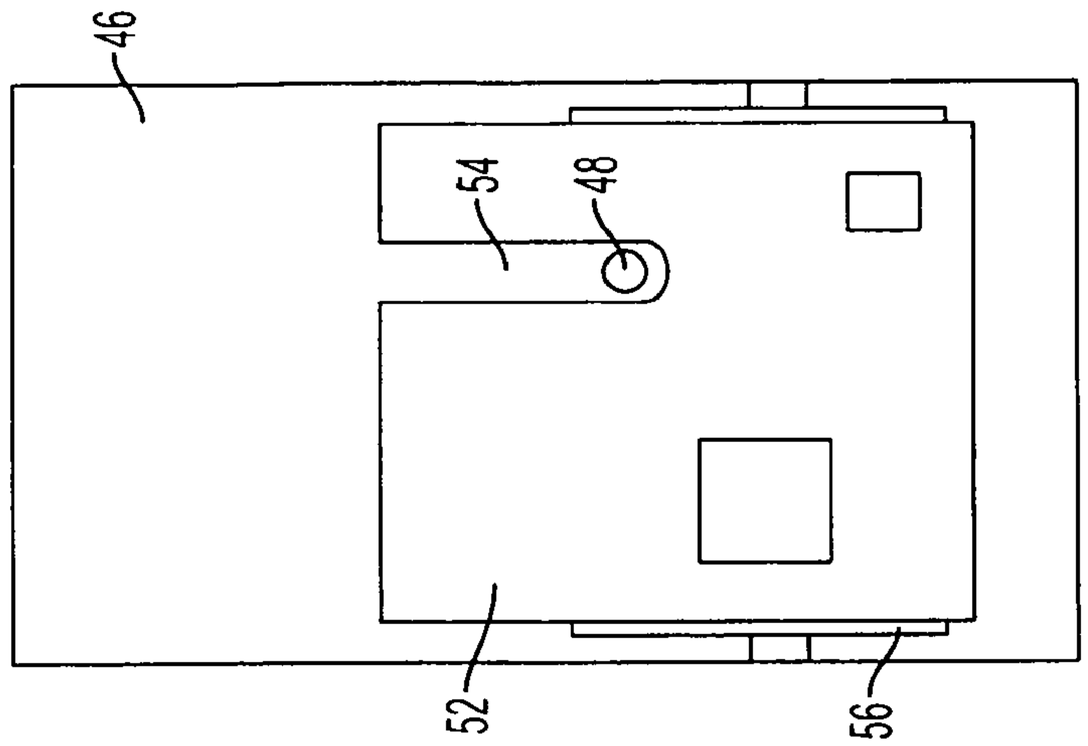


FIG. 4B

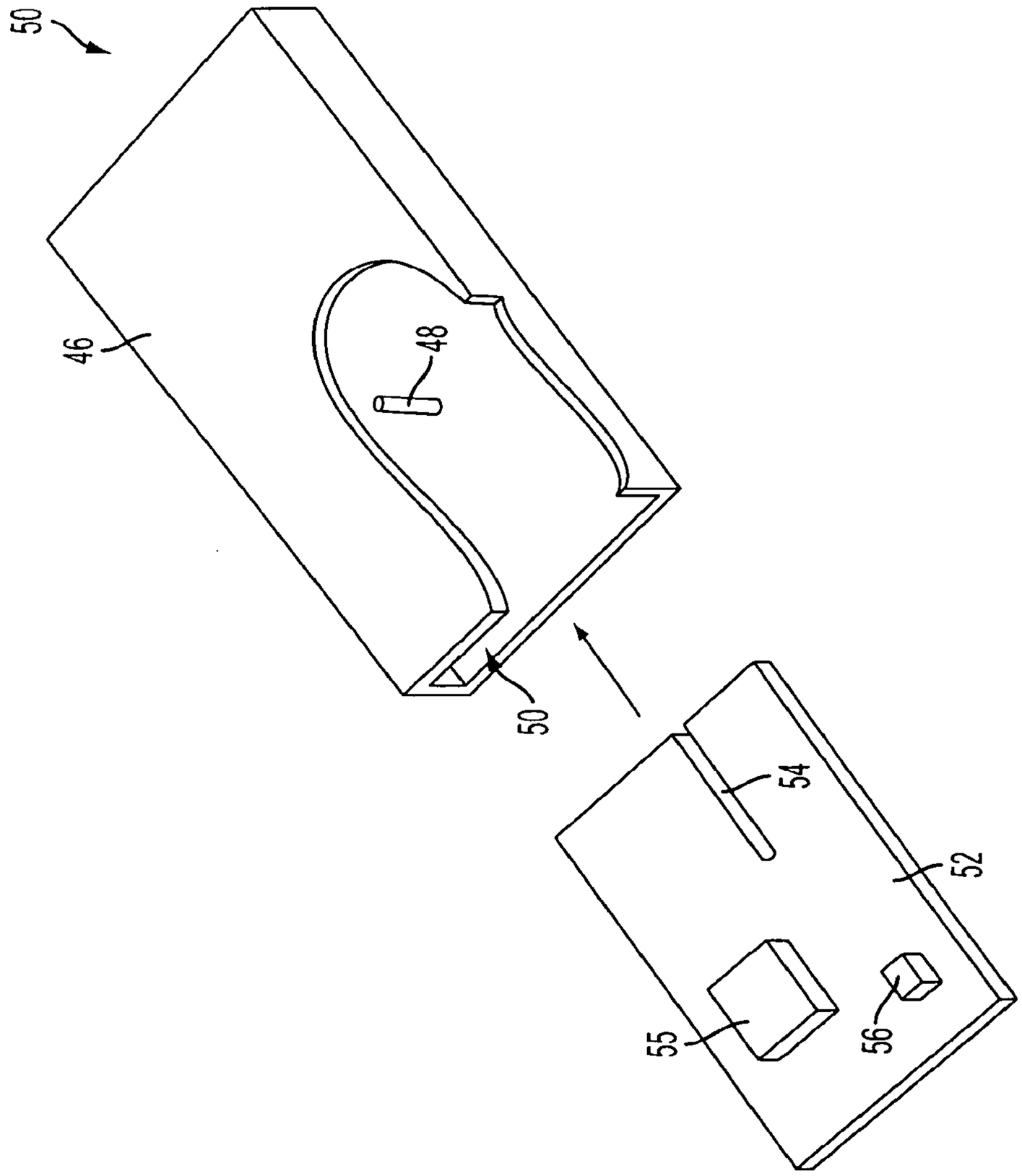


FIG. 4A

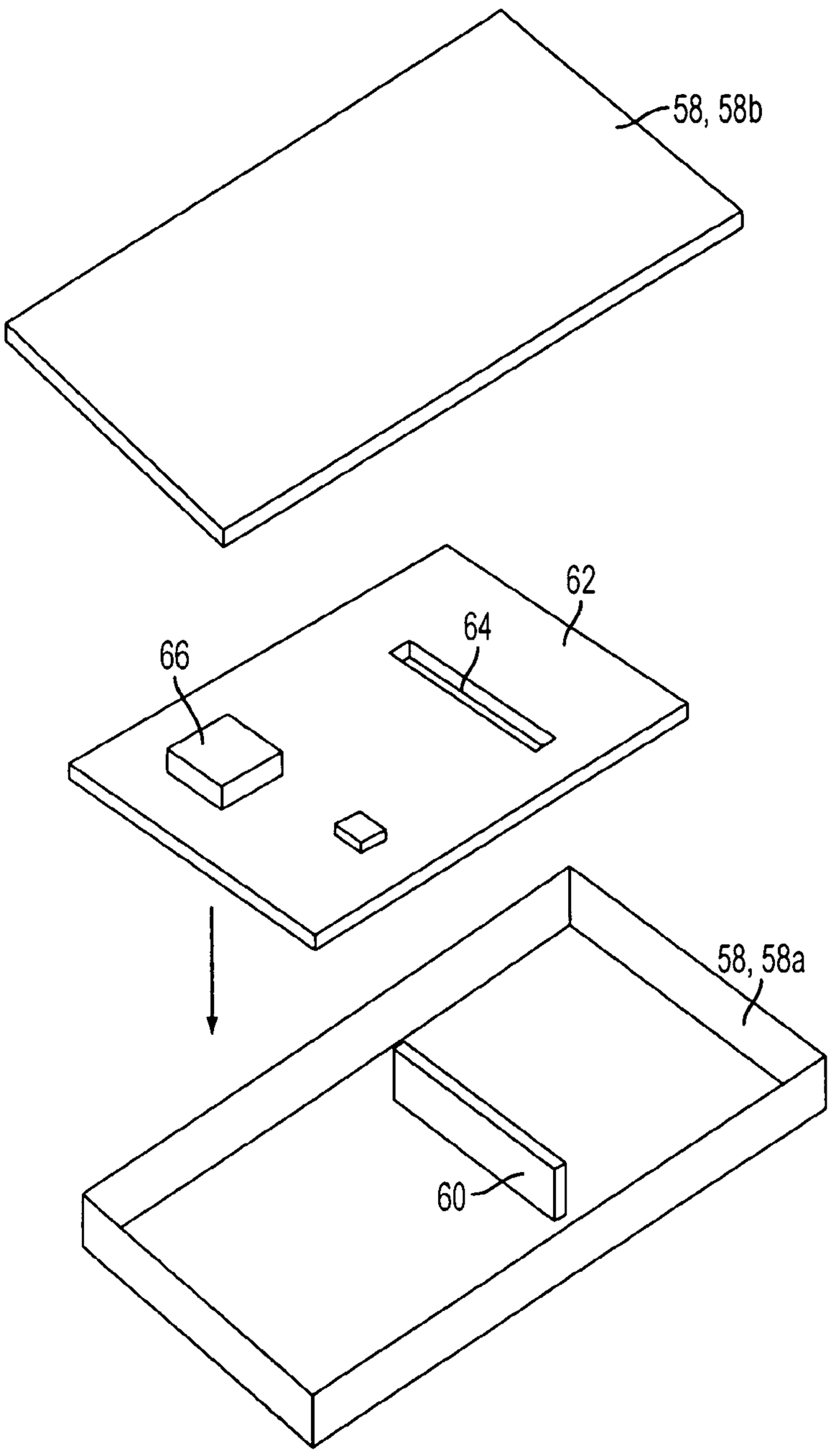


FIG. 5A

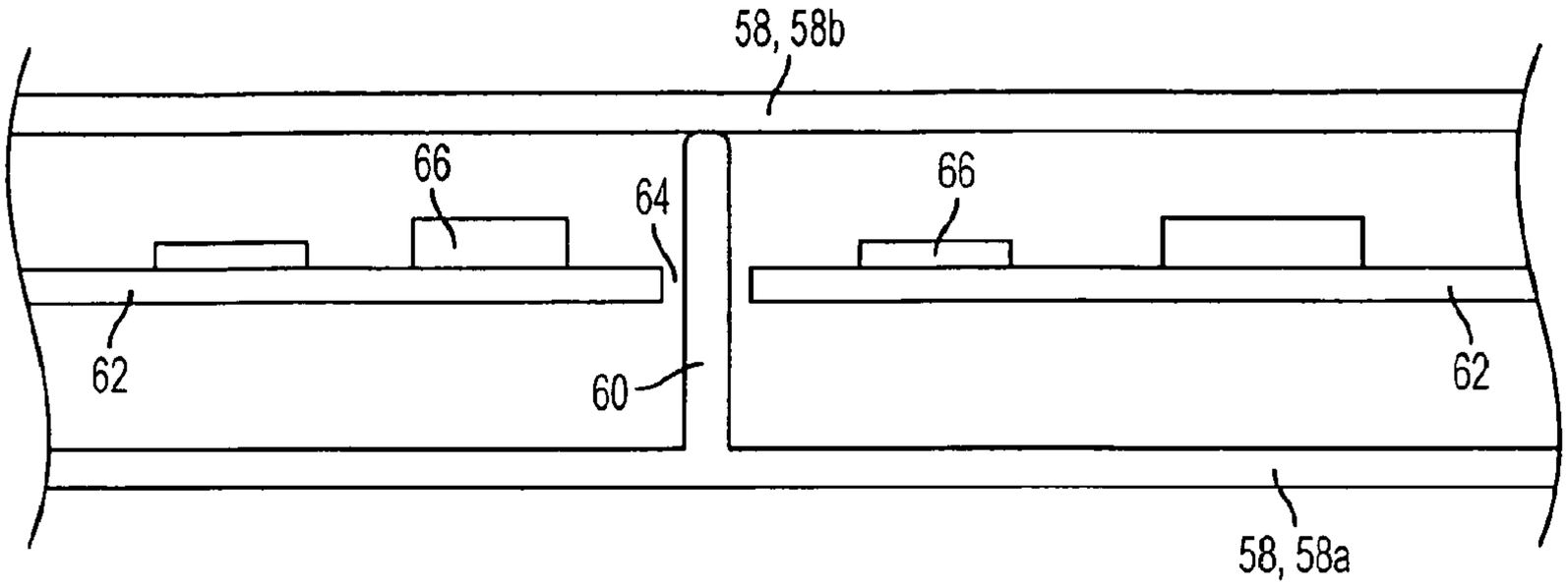


FIG. 5B

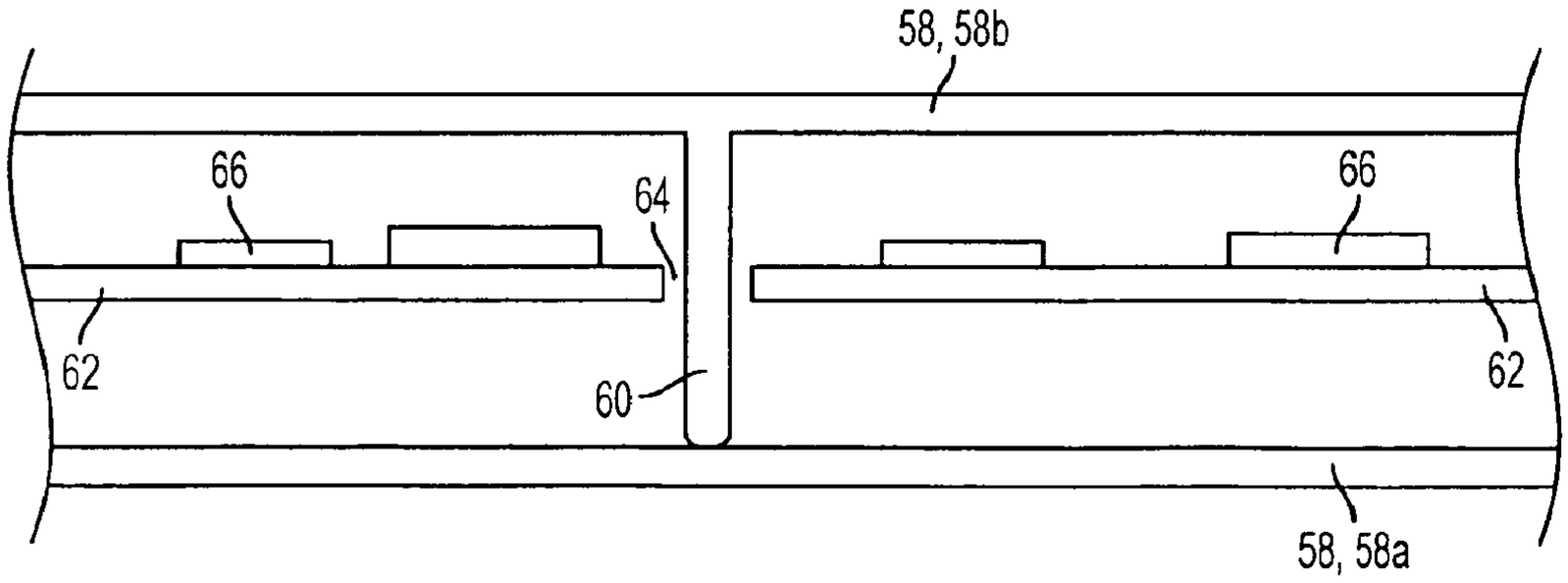


FIG. 5C

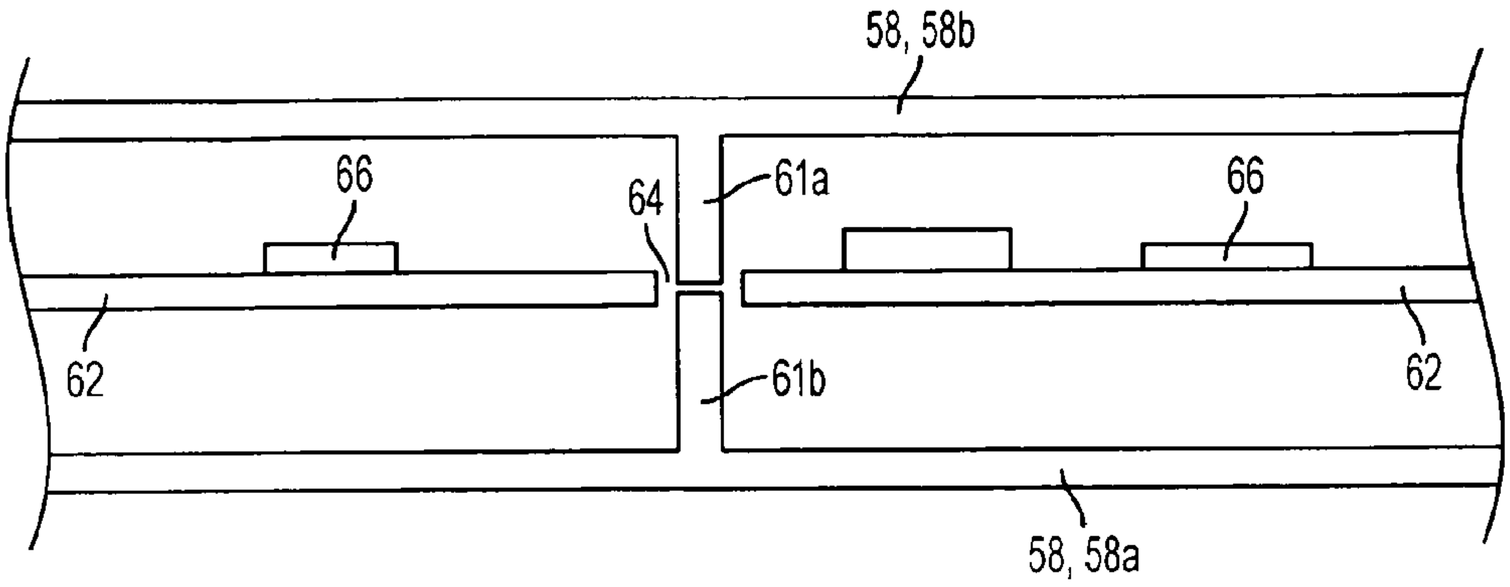
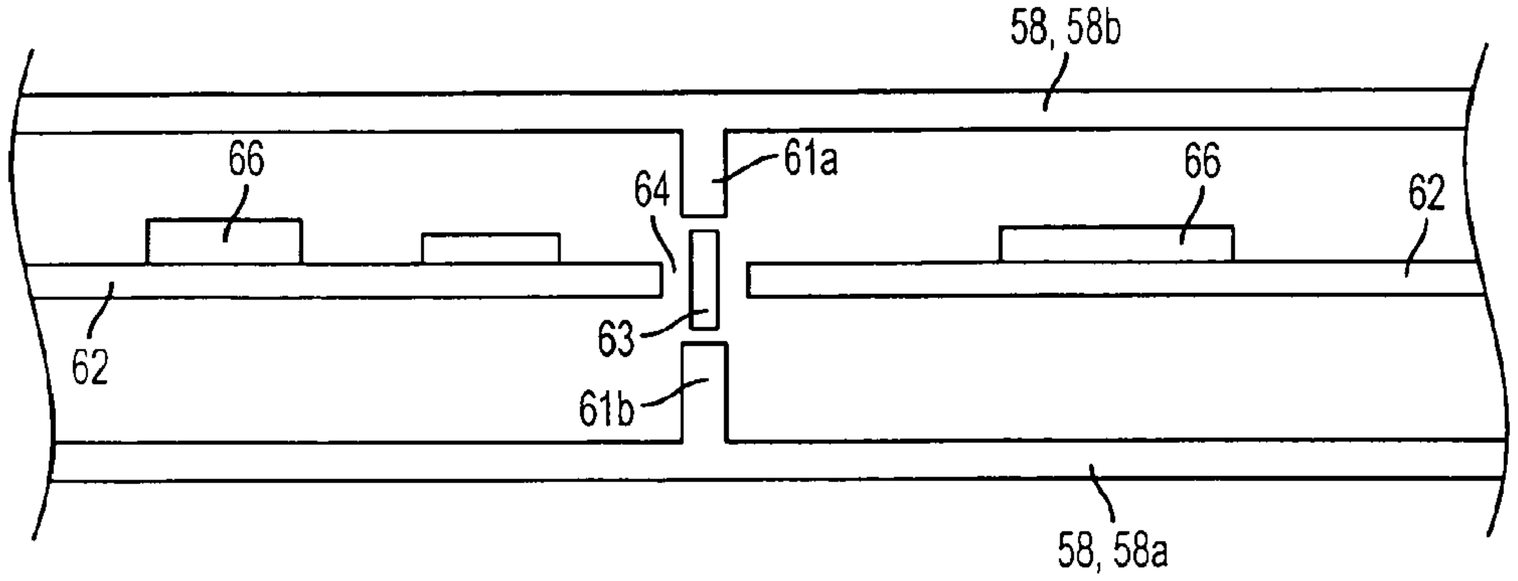

58, 58b
66
64
61a
66
62
61b
62
58, 58a

FIG. 5D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61a
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58, 58a

FIG. 5E

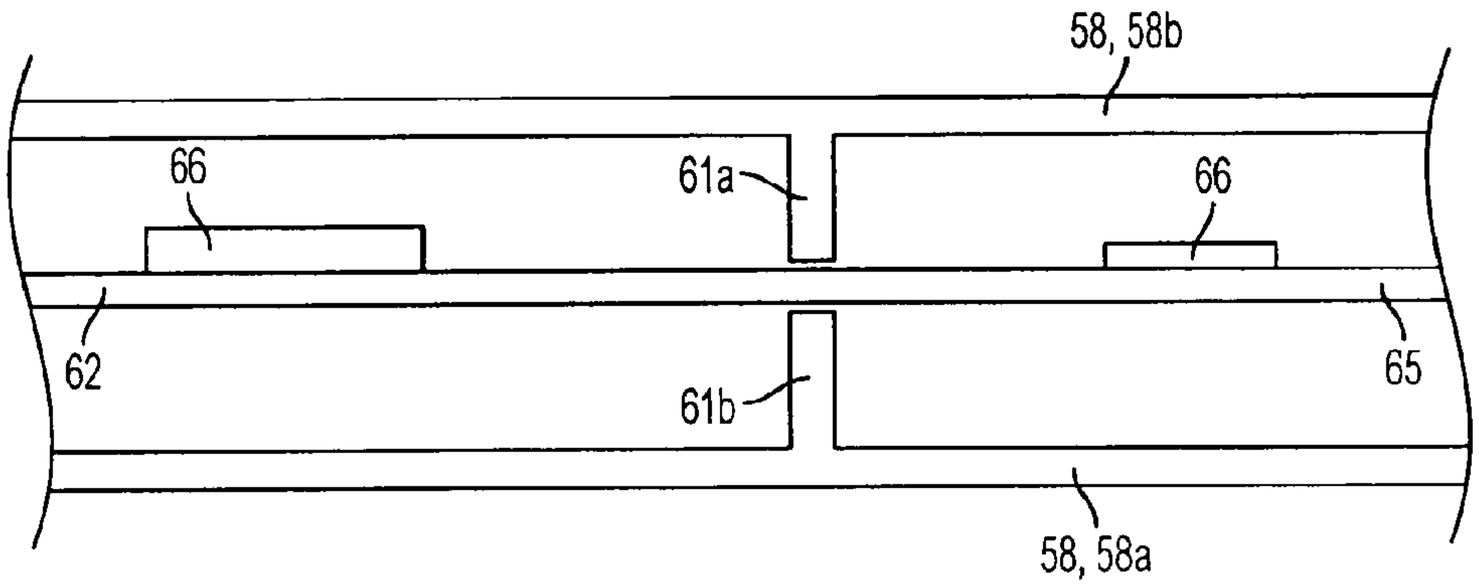

FIG. 5F

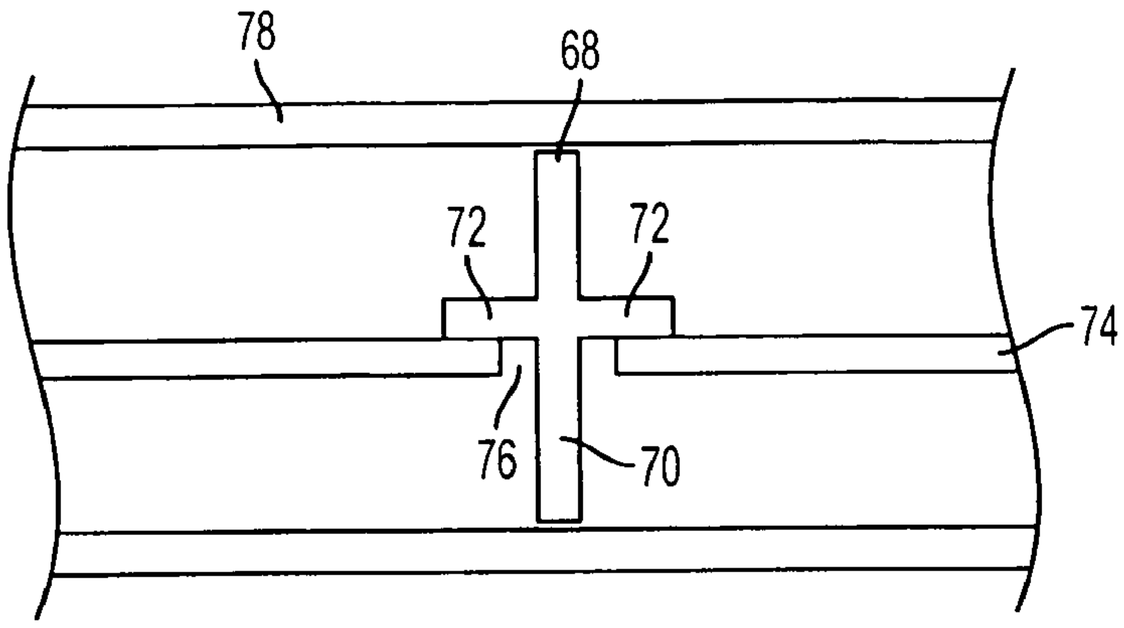

FIG. 6A

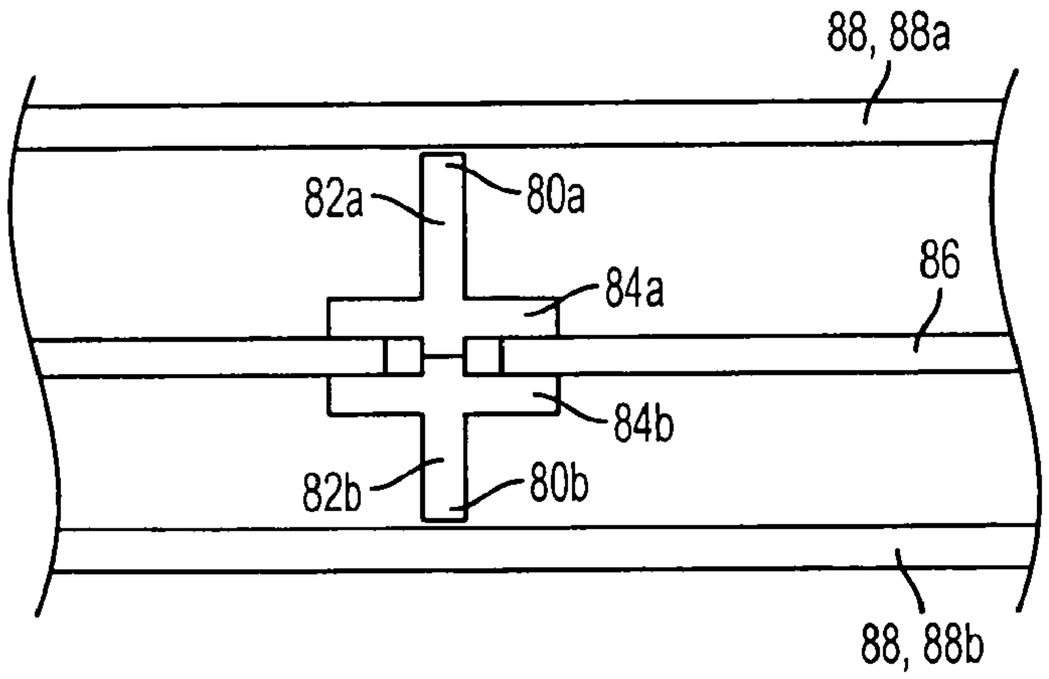

FIG. 6B

SUPPORT TABS FOR PROTECTING A CIRCUIT BOARD FROM APPLIED FORCES

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a divisional of U.S. patent application Ser. No. 12/791,610, filed on Jun. 1, 2010, which is a divisional of U.S. patent application Ser. No. 11/519,387, filed Sep. 11, 2006 and issued as U.S. Pat. No. 7,751,199, which are all hereby incorporated by reference.

FIELD OF THE INVENTION

The present invention can relate to methods and apparatus for supporting a circuit board and protecting the circuit board from applied compressive forces.

BACKGROUND OF THE INVENTION

Circuit boards disposed inside of consumer electronics are often fragile. As products get smaller and thinner, the distance between the circuit board and the housing of the electronic device is therefore often reduced. In this case, circuit boards may become more susceptible to damage, particularly from externally applied forces having components that are normal to the plane of the circuit boards. For example, such forces may be applied when the electronic device is placed inside a user's pocket or when the user repeatedly presses buttons on the electronic device.

When an external normal force is applied to an electronic device in which the distance between the circuit board and the housing is small, the inside wall of the housing or components disposed between the housing and the circuit board can come into contact with the circuit board (and components disposed on the circuit board) and cause damage. Also, repetitive strain on the circuit board may cause components attached to the board to detach, e.g., from failure of solder connections of a BGA (Ball Grid Array). These failures can result in failure of the product to function, which in turn results in field returns.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide methods and apparatus for supporting a circuit board and protecting the circuit board from externally applied forces.

In accordance with the present invention, an electronic device is provided that can have one or more support tabs disposed therein. Each support tab can be disposed substantially orthogonal to a circuit board in the electronic device. Some support tabs can traverse holes or slots disposed through the circuit board.

Each tab can buttress the housing of the device when a compressive force is applied, thereby protecting the circuit board. That is, each tab can reduce the likelihood that the housing of the electronic device will contact and potentially damage the circuit board.

Each tab may be disposed on a frame to which the circuit board is assembled. Each tab also may be disposed on another structure of the electronic device, such as the housing of the electronic device.

When the electronic device is fully assembled, one or more tabs may be disposed within or near the central region of the circuit board or electronic device. One or more additional tabs may be disposed on or near the edges of the circuit board or electronic device.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other objects and advantages of the present invention will be apparent upon consideration of the following detailed description, taken in conjunction with accompanying drawings, in which like reference characters refer to like parts throughout, and in which:

FIG. **1**A illustrates an exemplary electronic device that can incorporate the present invention;

FIG. **1**B illustrates the damage that the electronic device can sustain when subjected to a compressive force;

FIG. **2** illustrates an exploded view of some components of the electronic device of FIG. **1**A, incorporating one embodiment of the present invention;

FIG. **3**A illustrates a section view of the electronic device of FIG. **1**A, incorporating one embodiment of the present invention;

FIG. **3**B illustrates an enlarged view of FIG. **3**A;

FIG. **3**C illustrates another section view of the electronic device of FIG. **1**A, incorporating one embodiment of the present invention;

FIG. **3**D illustrates an enlarged view of FIG. **3**C;

FIG. **3**E illustrates "blind" assembly of some of the components of the electronic device into a housing in accordance with the present invention;

FIGS. **4**A and **4**B illustrate a second embodiment of the present invention;

FIGS. **5**A-F illustrate a third embodiment of the present invention; and

FIGS. **6**A and **6**B illustrate fourth and fifth embodiments of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

FIG. **1**A illustrates an exemplary electronic device that can incorporate the present invention. Electronic device **10**, e.g., an iPod™ sold by Apple Computer, Inc. of Cupertino, Calif., can be a hand-held consumer electronic device having circuit board **12** (see FIG. **1**B) disposed therein. As device **10** is designed to be smaller and thinner, the distance between circuit board **12** and an inner surface of housing **14** of device **10** can become increasingly smaller. This can cause circuit board **12** to become increasing susceptible to damage from compressive force F applied to device **10** during use, e.g., when a user presses buttons on electronic device **10**.

FIG. **1**B illustrates what can occur when force F is applied externally to device **10**. Depending on the magnitude and angle of applied force F, normal component Fz of force F can cause housing **14** to deform and contact circuit board **12** (including components **16** disposed on the circuit board). If normal component Fz is strong enough, it can damage circuit board **12** and components **16** (e.g., by shorting out electronic circuits or breaking the board). Repetitive strain on circuit board **12** may cause solder joints **18** to fail. As used herein, the term "circuit board" includes, among other things, the electronic components disposed thereon.

One of skill in the art will understand that FIG. **1**B provides an illustration of certain modes of damage. Other modes of damage also may result from applied force F. Also, while FIG. **1**B illustrates contact between housing **14** of device **10** and circuit board **12**, device **10** also can incorporate other intervening components between the housing and the circuit board. When a compressive force is applied to the housing, that force can be transmitted to the intervening components and can cause similar modes of damage.

The present invention can reduce the risk of damage to the circuit board by reducing the likelihood that the housing of

the electronic device or the intervening components will contact the circuit board when an external force is applied to the housing. The present invention can accomplish this by incorporating one or more support tabs disposed to resist the normal component of the applied force. Thus, when an external force having a normal component is applied to the electronic device, each tab can buttress the housing of the electronic device (either directly or through one or more intervening components). This reduces the likelihood that the housing will deform sufficiently to damage the circuit board.

FIG. **2** shows a first embodiment of the present invention. Assembly **20** can include user input component **22**, stiffener plate **24**, circuit board **26**, and frame **28**.

User input component **22** can provide an interface for a user to input information into the electronic device. In one embodiment of the present invention, user input component **22** may be a trackwheel similar to that used by the iPod™. The trackwheel can include one or more buttons for selecting software entries and a capacitive touchpad. The touchpad may permit a user to scroll through software menus. In alternative embodiments, user input component **22** may include, for example, one or more buttons, a touchpad, a touchscreen display, electronics for accepting voice commands, antennas, infrared ports, or combinations thereof.

Stiffener plate **24** can provide increased structural integrity to the electronic device, particularly in an area that may receive increased strain from a user interacting with user input component **22**. User input component **22** may be coupled to stiffener plate **24**, which in turn may be attached to an inside surface of housing **14** or another structure.

In one embodiment of the present invention, frame **28** can have first and second side struts **29***a* and **29***b* coupled by central strut **29***c*. Central support tab **38** can be disposed on the central strut. In one embodiment of the present invention, the central support tab is centered on the central strut. In alternative embodiments, the central support tab can be disposed in another location on the central strut. In alternative embodiments, frame **28** also can include additional struts or less struts depending on the configuration of the components inside the electronic device.

Circuit board **26** may be configured to be assembled to frame **28**, which may or may not be affixed to the housing of the electronic device, either directly or indirectly via another component of the device. Circuit board **26** may also incorporate slot **36**, which preferably is dimensioned to permit central support tab **38** on frame **28** to be inserted in a clearance fit. When circuit board **26** is coupled to frame **28**, central support tab **38** can traverse slot **36** and protrude above the top plane of circuit board **26**. Circuit board **26** also can comprise tabs **42***a* and **42***b*. When inserted or snapped into slots **44***a* and **44***b* of frame **28**, tabs **42***a* and **42***b* can secure circuit board **26** into frame **28**.

In one embodiment of the present invention, central support tab **38** may remain unattached to circuit board **26** at slot **36**. By structurally uncoupling the central support tab from the circuit board at the slot, the support tab may be less likely to transfer stress the support tab experiences to the circuit board. In alternative embodiments, central support tab **38** may be attached to circuit board **26** at slot **36**, for example, by adhesive or solder deposited in the slot between the support tab and the circuit board or by mechanical clips disposed in the slot that couple the support tab to the circuit board. Other means also may be used to attach the central support tab to the circuit board at slot **36**.

As used herein, the term "central support tab" means that the support tab traverses the circuit board via a hole or slot disposed through the circuit board when the electronic device is fully assembled. By no means does the term indicate that the support tab must be located in the center of the circuit board. However, it can be advantageous to incorporate a support tab in the central region of the circuit board because it inherently is the most susceptible to strain. Comparatively, support tabs disposed near the outer perimeter or edges of the circuit board may not provide as great of an advantage as a support tab located near the central region because the device usually is stiffer near the side wall.

FIGS. **3**A and **3**B provide a sectional view of the central region of assembly **20** when it is disposed within housing **14** of electronic device **10**. As shown in FIGS. **2**, **3**A, and **3**B, support tab **38** can be integral to frame **28**. Support tab **38** may have a height that substantially bridges the distance between the bottom wall of housing **14** and stiffener plate **24**. When a force is applied to either the top or bottom face of electronic device **10**, support tab **38** can buttress housing **14** (in part through stiffener plate **24**), reducing the likelihood that housing **14** or stiffener plate **24** will deform enough to damage circuit board **26** and/or components **34**. Alternatively, support tab **38** may have a shorter height so that either end of the support tab terminates at an intermediate point between circuit board **26** and a component adjacent to the circuit board. In the later configuration, the support tab may still protect the circuit board by buttressing the housing (either directly or through stiffener plate **24**) if a compressive force causes the housing to deform and contact the support tab.

FIGS. **3**C and **3**D provide a sectional view of the side of assembly **20** when it is disposed in electronic device **10**. As shown in FIGS. **2**, **3**C and **3**D, frame **28** can incorporate support tabs **40***a* and **40***b* disposed on side struts **29***a,b* of frame **28**, in addition to central support tab **38**. In one embodiment of the present invention, side support tabs **40***a,b* may be disposed at the ends of the first and second side struts. Because side struts **29***a,b* structurally may be more sound at side support tabs **40***a,b*, slots **44***a,b* may be disposed through the side support tabs. In alternative embodiments of the present invention, side support tabs **40***a,b* and slots **44***a,b* can be disposed at other locations on the side struts of the frame.

Support tabs **40***a,b* may share a common height with central support tab **38**. In one embodiment of the present invention, the support tabs may share a common height that substantially bridges the distance between the bottom wall of housing **14** and stiffener plate **24**. Alternatively, side support tabs **40***a,b* may have a different height than that of central support tab **38** and/or each other. This may occur, for example, when other components of the electronic device are disposed between one of the support tabs and the housing, but not between the other support tabs and the housing. Regardless of the heights of the support tabs, however, side support tabs **40***a* and **40***b* can buttress housing **14** (in part through stiffener plate **24**) when an external compressive force is applied to electronic device **10**.

As used herein, the term "side support tab" means that the support tab is disposed to resist compressive forces applied to the electronic device without requiring a hole or slot to be provided through the circuit board when the circuit board is attached to the frame. By no means does the term indicate that the support tab must be disposed at or near the edge of the circuit board.

In alternative embodiments of the present invention, slots **44***a,b* can be disposed at other locations on the frame rather than through support tabs **40***a,b*. Also, while circuit board **26** of FIGS. **2**, **3**C, and **3**D is designed to be snapped into slots **44***a,b* in frame **28**, the circuit board also can be attached to the frame in a different manner known in the art or otherwise.

Frame **28** can serve an assembly function as well as a protective function for circuit board **26**. Many of the internal electronic components of electronic device **10**, e.g., the circuit board, the battery, and the display, may be pre-assembled to the frame and then inserted into the housing of the device. Preassembly of the components to frame **28** can facilitate manufacturing of device **10**, particularly in "blind" assembly situations explained in greater detail below with respect to FIG. **3**E. Once the frame is residing within the housing of the device, central support tab **38** and side support tabs **40***a* and **40***b* can protect the device from externally applied forces.

Advantageously, the first embodiment of the present invention can facilitate manufacturing electronic devices having certain housing designs. For example, the electronic device may be designed so that it may be more desirable to insert circuit board **26** and other components of the device into one or more openings **45** disposed on the sides (e.g., opposite ends) of the housing (see, e.g., FIG. **3**E). This can make it more difficult to incorporate support tabs into the electronic device when the circuit board and the other components are inserted "blind" into a housing. By disposing one or more support tabs **38** on frame **28** and pre-assembling the circuit board to the frame prior to insertion into the housing, the electronic device can obtain some protection from externally applied forces while still permitting components to be inserted "blind" into one end of the housing.

Referring now to FIGS. **4**A and **4**B, a second embodiment of the present invention is provided that also facilitates "blind" assembly of components into a housing of an electronic device. The embodiment of FIGS. **4**A and **4**B can comprise housing **46** of an electronic device having support tab **48** either manufactured with the housing or separately manufactured and coupled to the housing. Like the housing shown in FIG. **3**E, housing **46** may incorporate openings **50** to permit internal electronic components of electronic device **10**, e.g., an assembly of circuit board **52**, battery (not shown), display (not shown), and frame **56**, to be slid into the housing during manufacturing.

Circuit board **52** can comprise edge slot **54** through which support tab **48** slides when the circuit board is inserted into housing **46** via opening **50**. Edge slot **54** may be sufficiently wide to permit a clearance fit with respect to support tab **48**. Similar to central support tab **38** of FIGS. **2**-**3**B, support tab **48** also can be attached or unattached to circuit board **52** at edge slot **54**. As used herein, the term "edge slot" means that a surface of the slot is contiguous with a surface surrounding the perimeter of the circuit board.

In one embodiment, support tab **48** may have a height that bridges the distance between the bottom wall of housing **46** to which the support tab is coupled and the component adjacent to circuit board **52**, e.g., the top wall of housing **46** or a stiffener plate for a user input assembly. Support tab **48** also may have a shorter height that spans the distance from the bottom wall of housing **46** to an intermediate point between circuit board **52** and a component adjacent to the circuit board. In the later configuration, the support tab can still protect the circuit board by buttressing the housing (either directly or through components disposed between the housing and the circuit board) when a compressive force may cause the housing to deform and contact the support tab. Support tab **48** also may be located at alternative positions within the electronic device, e.g., coupled to the top wall of housing **46** rather than the bottom wall.

FIGS. **5**A-F show a third embodiment of the present invention that can have support posts that facilitate assembly of components into clamshell housings. The third embodiment can include housing **58** having bottom piece **58***a* and top piece **58***b*, support tab **60**, circuit board **62**, and other components of an electronic device (not shown). Circuit board **62** can comprise slot **64** through which support tab **60** can be disposed within the housing.

Support tab **60** may be manufactured with either bottom piece **58***a* or top piece **58***b* of housing **58** or separately manufactured and then attached to either bottom piece **58***a* or top piece **58***b*. In the embodiment of FIG. **5**B, support tab **60** may have a height that bridges the distance between bottom piece **58***a* of housing **58** to which the support tab is affixed and a component adjacent to circuit board **62**, e.g., top piece **58***b* of housing **58** or a stiffener plate for a user input assembly. In alternative embodiments, support tab **60** may have a shorter height that spans the distance from bottom piece **58***a* of housing **58** to an intermediate point between the top surface of components **66** and a component adjacent to circuit board **62**. In the later configuration, the support tab can still protect the circuit board by buttressing the housing (either directly or through components disposed between the housing and the circuit board) when a compressive force may cause the housing to deform and contact the support tab. In the embodiment of FIG. **5**C, support tab **60** may have a height that bridges the distance between top piece **58***b* to which the support tab is affixed and a component adjacent to circuit board **62**, e.g., bottom piece **58***a* of housing **58**.

FIGS. **5**D-F show alternative embodiments of the present invention that may be similar to the embodiments illustrated in FIGS. **5**A-C. Rather than having a support tab disposed from the top or bottom piece of the housing only, support tabs **61***a* and **61***b* may be disposed from both the top and bottom pieces of the housing. For example, top piece **58***b* of housing **58** may incorporate top support tab **61***a*, which descends from the top piece of the housing. Bottom piece **58***a* of housing **58** may incorporate bottom support tab **61***b*, which rises from the bottom piece of the housing.

In the embodiment of FIG. **5**D, top support tab **61***a* and bottom support tab **61***b* can be disposed in series so that the sum of the heights of both support tabs bridge the distance between bottom piece **58***a* and top piece **58***b*. When support tabs **61***a,b* are disposed in series, support tabs **61***a,b* effectively can form a single support tab disposed between top and bottom pieces **58***a,b* through slot **64** of the circuit board. Top support tab **61***a* and bottom support tab **61***b* can meet within slot **64** of circuit board **62**. Alternatively, the top and bottom support tabs can meet within housing **58** at a location that is above or below the circuit board.

In the embodiment of FIG. **5**E, top support tab **61***a* and bottom support tab **61***b* can protrude from respective top and bottom pieces of the housing to meet central support tab **64**. Central support tab **64** may be disposed on a frame to which circuit board **62** may be coupled, e.g., frame **28** of FIG. **2**. By disposing multiple support tabs in series, the sum of the heights of all of the support tabs bridge the distance between bottom piece **58***a* and top piece **58***b* of housing **58**.

Slot **64** of circuit board **62** may be designed to provide a clearance fit for support tabs **60**, **61***a*, or **61***b* when circuit board **62** is disposed within housing **58**. The support tabs can be attached or unattached to circuit board **62** at slot **64**.

FIG. **5**F illustrates an embodiment of the present invention that is similar to that shown in FIG. **5**E, except that central support tab **63** of FIG. **5**E may be replaced with circuit board **65**. Top support tab **61***a* and bottom support tab **61***b* can protrude from respective top and bottom pieces of the housing to meet top and bottom surfaces of circuit board **65**. By disposing top and bottom support tabs **61***a* and **61***b* in series between circuit board **62** and top and bottom pieces **58***b* and **58***a* (respectively), the sum of the heights of the support tabs

and the thickness of circuit board **65** bridge the distance between bottom piece **58***a* and top piece **58***b* of housing **58**.

FIG. **6**A shows a fourth embodiment of the present invention. The main difference between the embodiment of FIG. **6**A and the embodiments described above with respect to FIGS. **2**-**5**C is that support tab **68** of FIG. **6**A can be attached to circuit board **74**, and not a frame or housing of the electronic device. Support tab **68** can comprise trunk **70** and one or more flanges **72**. Support tab **68** can be affixed to circuit board **74** via flanges **72** by adhesive, solder, screws, or other means known in the art or otherwise. Circuit board **74** can comprise through-hole **76** through which a portion of trunk **70** may be disposed once the support tab is affixed to the circuit board. Through-hole **76** may provide a clearance fit for the support tab. Support tab **68** may have a height that bridges the distance between components of the electronic device adjacent to circuit board **74**, e.g., one or more walls of housing **78** and/or a stiffener plate for a user input assembly. Alternatively, support tab **68** may have a shorter height so that either end of the support tab terminates at an intermediate point between circuit board **74** and components adjacent to the circuit board. In the later configuration, the support tab may still protect the circuit board by buttressing the housing (either directly or through components disposed between the housing and the circuit board) when a compressive force may cause the housing to deform and contact the support tab.

FIG. **6**B illustrates a fifth embodiment of the present invention, similar to that of FIG. **6**A. The main difference between the embodiments shown in FIGS. **6**B and **6**A is that circuit board **86** of FIG. **6**B can be supported by two tabs **80***a* and **80***b* that together serve the function of support tab **68** of FIG. **6**A. In particular, each support tab **80***a,b* respectively may comprise trunk **82***a*,**82***b* and one or more flanges **84***a*,**84***b* by which each support tab is affixed to the circuit board. When support tabs **80***a* and **80***b* are attached to opposite surfaces of circuit board **86**, support tab **80***a* can buttress top wall **88***a* of housing **88** while support tab **80***b* can buttress bottom wall **88***b* of housing **88** to protect circuit board **86** from externally applied forces. One of ordinary skill in the art will understand that there may be intervening components disposed between circuit board **86** and the top and/or bottom walls of housing **88**. In that case, the supporting tabs can buttress the housing through those intervening components to protect the circuit board from damage.

Although particular embodiments of the present invention have been described above in detail, it will be understood that this description is merely for purposes of illustration. Alternative embodiments of those described hereinabove also are within the scope of the present invention. For example, a support tab of the present invention may comprise any cross-sectional shape, e.g. rectangular, circular, T-shaped, square, irregular, etc. Indeed, the cross-section of the support tab may vary along the height of the support tab. For example, the support tab may have indentations, holes, insets, and/or cutouts to accommodate other components of the electronic device when space is at a premium. Alternatively, support tabs can be used as a structural brace for other components in the device. The other components can be coupled to the support tab at indentations, slots, or cutouts in the support tab. Each support tab also may comprise shoulder-screws or have a tip on one or both ends of the tab so that the tabs resemble pins.

While the description of the embodiments presented herein may refer to holes or slots within the circuit boards through which central support tabs may be disposed, the term "hole" may be used interchangeably with the term "slot." Neither term is intended to indicate any particular cross-sectional shape. As used herein, the term "hole" may be a cutout having any cross-sectional shape. Examples can include circular holes, polygonal slots, edge slots similar to slot **54** of FIG. **4**A, or any other suitable configuration.

While some of the embodiments of support tabs described herein incorporate one central support tab, additional support tabs may be incorporated in a central region of the circuit board/electronic device or along edges of the circuit board/electronic device.

Each support tab also may be manufactured with the frame or housing on which it is disposed. Alternatively, each support tab may be manufactured separately from the frame or housing and subsequently attached. Attachment can be accomplished by methods known in the art or otherwise, including soldering, adhering, or screwing the components together.

Additionally, combinations of the above-described embodiments of the present invention or portions thereof may be provided in one electronic device unit. For example, an electronic device can incorporate side support tabs along with any of the other support tabs described hereinabove.

One of ordinary skill in the art will understand that, while certain embodiments described above facilitate certain manufacturing techniques (e.g., "blind" assembly or clamshell assembly) and/or housing designs, those embodiments are not necessarily limited thereto. For example, while the embodiment of FIGS. **2**-**3**D facilitate "blind" assembly of components into the electronic device housing, that embodiment of the present invention also may be used when a clamshell housing is more desirable. The present invention also may be incorporated into an electronic device having housings in which the main body of the housing includes multiple parts. An example of such a multi-part housing includes a clamshell housing. The housing of an electronic device of the present invention also may include housings in which the main body includes only one piece. An example of such a housing includes, e.g., the housings of FIGS. **3**A, **3**E, and **4**A. A housing of the present invention may provide only one opening through which components are inserted or multiple openings that can be disposed, for example, on multiple sides of the housing.

The present invention can be incorporated in any electronic device, including any portable, mobile, hand-held, or miniature consumer electronic device that may require protection from compressive forces applied thereto. Illustrative electronic devices can include, but are not limited to, music players, video players, still image players, game players, other media players, music recorders, video recorders, cameras, other media recorders, radios, medical equipment, calculators, cellular phones, other wireless communication devices, personal digital assistances, programmable remote controls, pagers, laptop computers, printers, or combinations thereof. Miniature electronic devices may have a form factor that is smaller than that of hand-held devices. Illustrative miniature electronic devices can include, but are not limited to, watches, rings, necklaces, belts, accessories for belts, headsets, accessories for shoes, virtual reality devices, other wearable electronics, accessories for sporting equipment, accessories for fitness equipment, key chains, or combinations thereof.

The above described embodiments of the present invention are presented for purposes of illustration and not of limitation, and the present invention is limited only by the claims which follow.

What is claimed is:

1. An electronic device comprising:

a housing having a housing surface;

a stiffener plate for supporting a user input component of the electronic device;

a circuit board disposed within the housing, the circuit board having top and bottom circuit board surfaces;

a first support tab extending from a surface of the stiffener plate to the top circuit board surface; and

a second support tab extending from the housing surface to the bottom circuit board surface.

2. The electronic device of claim **1**, further comprising a user input component.

3. The electronic device of claim **1**, further comprising a frame to which the circuit board is coupled.

4. The electronic device of claim **3**, wherein the frame comprises at least one side support tab.

5. The electronic device of claim **1**, further comprising a third support tab, wherein:

the circuit board comprises a hole disposed therethrough; and

the third support tab is disposed through the hole in the circuit board when the electronic device is fully assembled.

6. The electronic device of claim **5**, wherein the third support tab is disposed in series between the first support tab and the second support tab when the electronic device is fully assembled.

7. The electronic device of claim **6**, further comprising a frame on which the third support tab is disposed.

8. The electronic device of claim **7**, wherein the circuit board is coupled to the frame.

9. The electronic device of claim **8**, wherein the circuit board is unattached to the third support tab.

10. The electronic device of claim **1**, wherein at least one of the first and second support tabs is coupled to the housing.

11. The electronic device of claim **1**, wherein:

the circuit board comprises a hole disposed therethrough; and

the first and second support tabs meet within the hole.

12. The electronic device of claim **1**, wherein:

the circuit board comprises a hole disposed therethrough;

one of the first and second support tabs extends through the hole; and

the first and second support tabs meet between the circuit board and the housing surface.

13. The electronic device of claim **1**, wherein at least one of the first and second support tabs buttresses the housing when an external force is applied to the electronic device.

14. The electronic device of claim **1**, wherein the first and second support tabs are provided by a single support tab.

15. The electronic device of claim **14**, wherein:

the circuit board comprises a hole disposed therethrough;

the single support tab extends through the hole; and

the single support tab is coupled to the housing surface.

16. The electronic device of claim **1**, wherein the sum of the heights of the first and second support tabs and the thickness of the circuit board bridge the distance between the surface of the stiffener plate and the housing surface.

17. The electronic device of claim **1**, wherein at least one of the first and second support tabs is attached to the circuit board.

18. The electronic device of claim **17**, wherein the at least one of the first and second support tabs is not attached to the housing.

19. The electronic device of claim **1**, wherein:

the first support tab is attached to the top circuit board surface; and

the second support tab is attached to the bottom circuit board surface.

20. The electronic device of claim **19**, wherein at least one of the first and second support tabs is not attached to the housing.

21. An electronic device comprising:

a first component;

a second component;

a circuit board disposed between the first component and the second component; and

at least one support tab, wherein:

a first portion of the at least one support tab is at least partially disposed between the first component and the circuit board; and

a second portion of the at least one support tab is at least partially disposed between the second component and the circuit board, wherein the first component comprises a stiffener plate for supporting a user input component of the electronic device.

22. The electronic device of claim **21**, wherein the first component comprises a first housing component of a housing of the electronic device.

23. The electronic device of claim **22**, wherein the second component comprises a second housing component of the housing of the electronic device.

24. The electronic device of claim **22**, wherein the second component comprises at least a portion of a user input component.

25. The electronic device of claim **21**, wherein the first component comprises at least a portion of a user input component of the electronic device.

26. The electronic device of claim **21**, wherein the at least one support tab buttresses at least one of the first component and the second component when an external force is applied to the electronic device.

27. The electronic device of claim **21**, wherein the at least one support tab protects the circuit board by buttressing the first component and the second component.

28. The electronic device of claim **21**, wherein:

the circuit board comprises a hole disposed through the circuit board; and

a third portion of the at least one support tab is disposed through the hole.

29. The electronic device of claim **28**, wherein the at least one support tab is attached to at least one of the first component and the second component.

30. The electronic device of claim **29**, wherein the at least one support tab is not attached to the circuit board.

31. The electronic device of claim **29**, wherein the at least one support tab is attached to the circuit board.

32. The electronic device of claim **21**, wherein:

the first portion of the at least one support tab comprises a first support tab of the at least one support tab; and

the second portion of the at least one support tab comprises a second support tab of the at least one support tab.

33. The electronic device of claim **32**, wherein:

the first support tab is attached to at least one of the first component and the circuit board; and

the second support tab is attached to at least one of the second component and the circuit board.

34. The electronic device of claim **32**, wherein:

the first support tab is attached to the first component;

the first support tab is not attached to the circuit board;

the second support tab is attached to the second component; and

the second support tab is not attached to the circuit board.

35. The electronic device of claim **34**, wherein:

the circuit board comprises a hole disposed through the circuit board; and

at least one of the first support tab and the second support tab is at least partially disposed in the hole.

36. The electronic device of claim **34**, wherein:

the circuit board comprises a hole disposed through the circuit board; and

a third support tab of the at least one support tab is disposed in the hole.

37. The electronic device of claim **36**, wherein the first support tab, the second support tab, and the third support tab are not attached to one another.

38. The electronic device of claim **36**, wherein:

the third support tab is disposed on a frame; and

the circuit board is coupled to the frame.

39. The electronic device of claim **32**, wherein the first support tab is attached to the circuit board.

40. The electronic device of claim **39**, wherein the second support tab is attached to at least one of the second component and the circuit board.

41. The electronic device of claim **39**, wherein:

the circuit board comprises a hole disposed through the circuit board; and

the second support tab is attached to at least one of the circuit board and the first support tab through the hole.

42. The electronic device of claim **32**, wherein the first support tab is attached to the circuit board by at least one of an adhesive, a solder, and a screw.

43. The electronic device of claim **32**, wherein the first support tab comprises:

a trunk extending between the first component and the circuit board; and

a flange extending from the trunk along a surface of the circuit board.

44. A method for manufacturing an electronic device comprising a first component, a second component, a circuit board, and at least one support tab, the method comprising:

positioning the circuit board between at least a first portion of the at least one support tab and at least a second portion of the at least one support tab; and

positioning the circuit board and the at least one support tab between the first component and the second component, wherein the second component comprises a stiffening plate of a user component of the electronic device.

45. The method of claim **44**, wherein:

the first component comprises a first housing component of a housing of the electronic device; and

the second component comprises a second housing component of the housing of the electronic device.

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